ufficio parlamentare di bilancio

upB

Nowcasting at the Italian Fiscal Council

Libero Monteforte

Parliamentary Budget Office (PBO)

Bratislava, 23 November 2018

Outline

- ✓ Introduction
  - ✓ Nowcasting for IFI's
- ✓ Nowcasting at PBO:
  - ✓ Introduction
  - ✓ The different approaches:
    - Mixed Frequency models
    - Dynamic factor models
    - The model for industrial production
  - ✓ Three years of nowcasting
- ✓ Summary and Conclusion

Introduction

- ✓ Macroeconomic indicators are released with delays.
- ✓ E.g. in Italy, since May 2018, Quarterly National Accounts (NA) are published with a delay of 45 days (30 days for GDP).
- ✓ The (short term) outlook requires estimates of the economic variables in the time interval between the beginning of the reference period and the date of the official release.
- ✓ "Nowcasting" is the prediction of the current (or the very near past and future) economic conditions.
- ✓ The idea is to exploit the information content of indicators, released with a higher frequency and shorter delay, highly correlated with the target variables.

Nowcasting for IFI's

- ✓ Considering the delay of official National Accounts (NA), budget documents are prepared with only a partial knowledge of the main macroeconomic variables (GDP, Consumption, Investment, Net exports). e.g. in Autumn only the first two quarters of the current year are known; in Spring no info from NA on the current year.
- ✓ Therefore nowcasting/forecasting the two remaining quarters of the year is crucial in order to fulfill the macroeconomic framework (MF).
- ✓ The first year of the MF is generally "closed" by using short term models, while the medium term forecasts are based on structural models.
- ✓ The first year is very relevant as it represents the starting point to initialize medium term scenario.

Nowcasting for IFI's (cont.)

- ✓ Quarterly short term forecasts are useful in order to judge the plausibility of annual official forecasts (for the current and following year).
- ✓ The carry-over effect induced by short term forecast in autumn is crucial to understand whether the prevision of growth in the next year is plausible or not.
- ✓ E.g. in the policy scenario of the latest Update of the Economic and Financial Document, the Italian Government estimates a GDP growth in 2019 at 1.5%. Given quarterly available figures this means an extreme acceleration of growth starting from the first quarter of 2019.

Nowcasting at PBO: the variables

We have different models for several macroeconomic variables:

- ✓ GDP
- ✓ Components of demand (Consumption, Investment, Imports, Exports);
- ✓ Sectoral value added (Agriculture, Manufacture, Services, Constructions);
- ✓ Industrial production;
- ✓ CPI.

The models used at UPB

- We use different type of models for short term forecasting: Bridge models, Mixed Frequency Models, MIDAS models, Factor Models.
- Some of them estimate the GDP directly, in others there is an aggregation of components (either on the demand or on the sectors).
- Very often the indicators are monthly and thus the issue of mixed frequency arises.
- In some models there is a small bunch of pre-selected (very informative) indicators, in others a large database is used, leaving to the model the extraction of the relevant information.
- The results are assessed in term of their statistical properties (significance of estimated parameters, forecasting error).
- The horizon of the real time forecasts is up to two quarters ahead.

GDP, supply and demand side

GDP is the most important variable, therefore we use many and different type of models to forecast it; this is consistent with the prescription of the literature on economic forecasting (just to mention recent contributions, see Amisano-Geweke, REST, 2017 and Chan-Pauwels, IJF, 2018):

- Bridge models – Bovi, B., Lupi C. and C. Pappalardo (2000) "Predicting GDP Components Using ISAE Bridge Equations Econometrics Forecasting Model (BEEF)", ISAE working papers. Baffigi A., Golinelli R., Parigi G., (2004),"Bridge models to forecast euro area GDP", IntJForecasting.

- 4 Mixed Frequency Models: 2 direct (1 with MIDAS), 2 by aggregation (demand and supply) Frale C., Marcellino M., Mazzi G., Proietti T. (2010) – "EUROMIND: a monthly indicator of the euro area economic conditions", JRSS 2010; Frale C. and Monteforte L. (2011) "FaMIDAS: A Mixed Frequency Factor Model with MIDAS structure," (Economic working papers) 788, Bank of Italy.

- Dynamic Factor Models and Diffusion Index: combination of 251 models Bai, J. and S. Ng (2008), "Forecasting economic time series using targeted predictors", JEconometrics. Bai, J. and S. Ng (2009), "Boosting diffusion indices", JAE. Forni, M., M. Hallin, M. Lippi, and L. Reichlin (2003), "Do financial variables help forecasting inflation and real activity in the euro area?" JME. Forni, M., M. Hallin, M. Lippi, and L. Reichlin (2005), "The generalised dynamic factor model: One sided estimation and forecasting", JASA. Stock, J. H. and M. W. Watson (2002a), "Forecasting using principal components from a large number of predictors", JASA .

Consistency among GDP components

- The models for expenditures and sectoral components are also useful in order to produce and additional forecast on GDP, made by chain-linking aggregation.

- We use the standard National Accounts identities:

$$GDP = Consumption + Total\ Investments\ + Exports - Imports$$
$$GDP = VA\ agriculture + VA\ industry + VA\ construction + VA\ services + net\ Taxes$$

- Moreover, the forecasts on the Industrial production are also plugged into the models for GDP.

- This approach ensure coherence among the estimates coming for different models, in order to get a unique picture of the economic prospects.

Bridge models

- ✓ BEEF: (B)ridge (E)quations (E)conometric (F)orecasting model is a small scale econometric model to forecast GDP and its demand components up to four quarters ahead.

- ✓ It consists of:
  - ✓ 19 models: 9 bridge equation (BE); 9 Vector AutoRegressive (VAR); models; 1 univariate ARMA model (for public consumption);
  - ✓ 7 linking equations (SE).

	VAR	ARMA	BE	SE
Consumption	2	1	2	2
GFCF	2		2	1
Export	2		2	1
Import	2		2	1
Inventories				1
GDP	1		1	1

Bridge models: information set

- ✓ Set of predictors: about 50 (39M and 9Q) time series.
- ✓ As for monthly indicators, selection according to their timeliness, coherence and relevance with respect to the target series.
  - ✓ soft data (consumer and business surveys + sector PMI);
  - ✓ hard data (including financial variables, like exchange rates and interest rates).
- ✓ Monthly raw series purged by possible outliers, calendar effects , seasonal patterns *via* Tramo/Seats (Gómez & Maravall, 1997).
  - ✓ In the case of missing observations, univariate autoregressive models are used to «close» the current quarter.
    - ✓ Exception: IPI forecasts obtained from an econometric model developed in-house (and discussed later on).

Industrial production

- ✓ Industrial Production (IP) is characterised by a large publication delay (T+45).

- ✓ Such a time lag limits its usefulness as predictor for the GDP and motivates the efforts to compute reliable and updated forecasts.

- ✓ Empirical framework
  - ✓ Target series = calendar adjusted IPI series
  - ✓ Set of indicators = about 70 series

- ✓ Econometric method
  - ✓ Forecast obtained from a number of (bivariate) conditional VAR models (timely available information can be fully exploited) (Clarida and Friedman (1984); van der Knoop (1988); Waggoner and Zha (1999); Bańbura, Giannone and Lenza (2015)).
  - ✓ Forecasts are subsequently aggregated through the Hierarchical Forecast Combination (HFC) procedure (Costantini and Pappalardo (2010); Kisimbay (2007)).

Mixed frequency models

- ✓ The econometric framework is that of the small size factor models: each series is decomposed into a common part (the common cycle) and specific idiosyncratic components.
- ✓ The model is estimated in levels and thus it is possible to disentangle the transitory component and the long term trend (potential GDP).
- ✓ The estimation is based on the Kalman filter which is suitable to handle the ragged-edge of the unbalanced samples (including series not available since the begin of the estimation sample or indicators released with different delay).
- ✓ The mixed frequency is solved inside the model so as to efficiently exploit the cross-correlation with the target variable (more efficient than simply averaging monthly series).

Mixed frequency models: information set

- ✓ The idea is to exploit the leading power of timely economic indicators to foresee GDP and its components dynamic.
- ✓ Indicators are chosen according to their statistical properties (correlation with the target, statistical significance, forecasting performance).
- ✓ Small scale structure. The researcher experience matters in doing the selection (few but relevant).
- ✓ Information set of Mixed freq. Models at UPB:

Quarterly national Accounts
IT INDUSTRIAL PRODUCTION (total and components)
CPB: TRADE BALANCE INDEX
IT RETAIL SALES VOLUME INDEX
IT PASSENGER CAR REGISTRATIONS
IT INDUSTRIAL PRODUCTION - CONSTRUCTION
IT FOREIGN TRADE: IMPORTS
IT FOREIGN TRADE: EXPORT
IT BUSINESS CONFIDENCE INDICATOR
IT ATTENDANCE IN HOTEL & OTHER ESTABLISHMENT
PRODUCTION OF MILK
PRODUCTION OF MEAT

Tot 39 series (22Q and 15M) from 1996

Dynamic factor model

- ✓ It is a set of quarterly models based on a medium scale set of indicators (including monthly indicators, aggregated to the quarterly frequency).
- ✓ It allows for different procedures to extract the common factor:
  - Standard dynamic factor models (Forni, Hallin, Lippi, Reichlin (2005))
  - Diffusion index (Bai, J. and S. Ng (2008))
  - Simple principal components (Stock, J. H. and M. W. Watson (2002a)
- ✓ Sophisticated methods to select indicators and factors are also applied:
  - LARS (Least Angles Regression): reg x_1 on y and get r_1; reg x_2 on r_1…
    (Efron B, Hastie T., Johnstone I., Tibshirani R. (2004))
  - Boosting : stepwise regression with a loss function to be minimized (Bai, J. and S. Ng (2009)).
- ✓ All variants (methods, number of lags, number of factors…) produce 251 forecasts that are combined with different weights (equal, based on forecasting error,…).

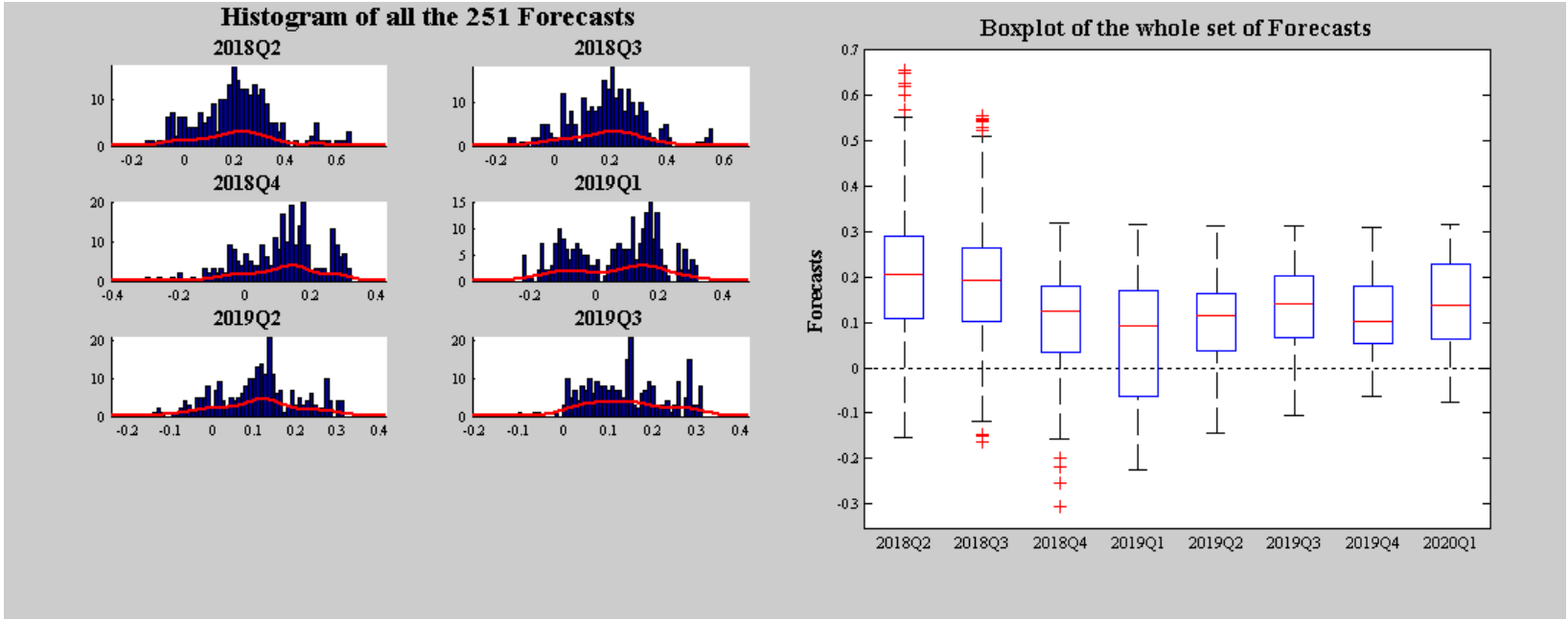
Dynamic factor model: Information set

GDP	ITALY EURO-LIRE T/N (FT/ICAP/TR)
CONSUMPTION	ITALY EURO-LIRE 1M (FT/ICAP/TR)
INVESTMENTS	ITALY EURO-LIRE 3M (FT/ICAP/TR)
EXPORTS	ITALY EURO-LIRE 6M (FT/ICAP/TR)
IMPORTS	ITALY EURO-LIRE 1 YR (FT/ICAP/TR)
GROSS VALUE ADDED total and by sector	ITALY EURO-LIRE 1WK (FT/ICAP/TR)
UNIT LABOUR COSTS - total and by sector	IT DISCOUNT RATE / SHORT TERM EURO REPO RATE NADJ
EMPLOYEE COMPENSATION - total and by sector	IT DISCOUNT RATE / SHORT TERM EURO REPO RATE (MTH.AVG.)
IT UNEMPLOYMENT RATE - LINKED NADJ	INTERBANK DEPOSIT RATE-AVERAGE ON 3-MONTHS DEPOSITS
EMPLOYEE COMPENSATION, total and by sector	EXPECTED GROSS MEAN YIELD: T-CREDIT CERTS.(CCT) WITH VAR. INT.
WAGE & SALARY EARNERS, total and by sector	GOVT BOND YIELD - LONGTERM
EMPLOYMENT, total and by sector	GOVT BOND YIELD - MEDIUM TERM
PRODUCTION OF TOTAL INDUSTRY, total and subcomponents	IT INTEREST RATES: MONEY MARKET RATE NADJ
TOTAL CAR REGISTRATIONS	IT INTEREST RATES: GOVERNMENT SECURITIES, TREASURY BILLS NADJ
STATE BUDGET: TAX REVENUE	MONEY SUPPLY: M1 - ITALIAN CONTRIBUTION TO THE EURO AREA
STATE BUDGET: CURRENT EXPENDITURE	MONEY SUPPLY: M2 - ITALIAN CONTRIBUTION TO THE EURO AREA
STATE BUDGET: CAPITAL EXPENDITURE	MONEY SUPPLY: M3 - ITALIAN CONTRIBUTION TO THE EURO AREA
STATE BUDGET: BALANCE	SHARE PRICES - ISE MIB STORICO
INDUSTRIAL CONFIDENCE INDICATOR - and subcomponents	IT BI PRICE COMPETITIVENESS INDICATOR-ITALY(METHO BREAK 0193)
IT CONSUMER CONFIDENCE INDICATOR and subcomponents	UNEMPLOYMENT RATE- (US;UK;FR)
CPI total and subcomponents	CPI (US;UK;FR;GR)
PPI: total and subcomponents	FEDERAL FUNDS RATE (AVG.)
REAL EFFECTIVE EXCHANGE RATE - CPI BASED	BANK OF ENGLAND BASE RATE (EP)
US CENTS TO EURO (EP)	PRIME RATE - LONG TERM (EP) Japan

Tot 143 series (78 Q e 65 M) from 1982

Dynamic factor model: results

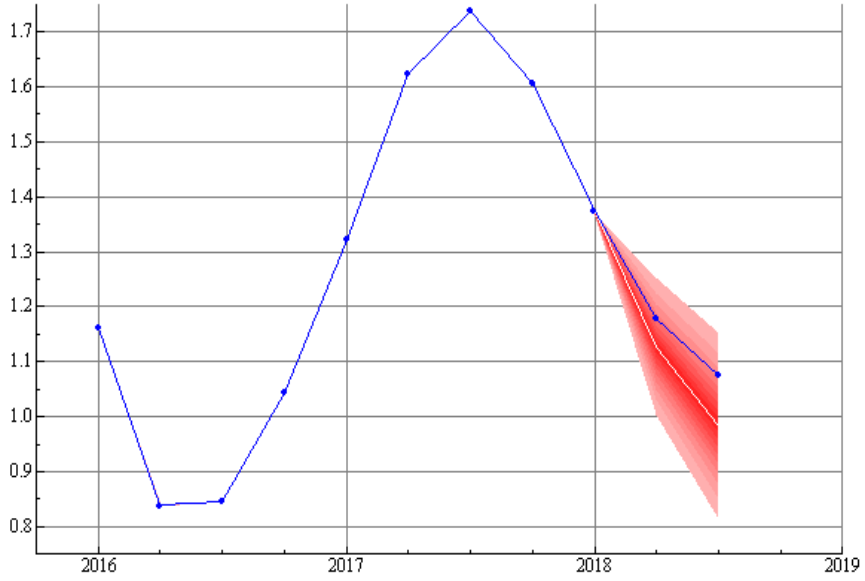
- ✓ The model produces quarterly forecast for GDP, Consumption, Investment, Import, Export and CPI up to 6q ahead (in growth rates)
- ✓ Therefore it represents a bridge between short term forecasts and annual forecasts made for the budget documents (e.g. in autumn the dynamic model produces forecast for the 2 missing quarters of the current year and for the four quarters of the following year)
- ✓ It is possible to construct a distribution of all 251 forecasts, that can be interpreted as a measure of uncertainty (see Monteforte and Luciani, 2013).



Nowcasting communication at PBO

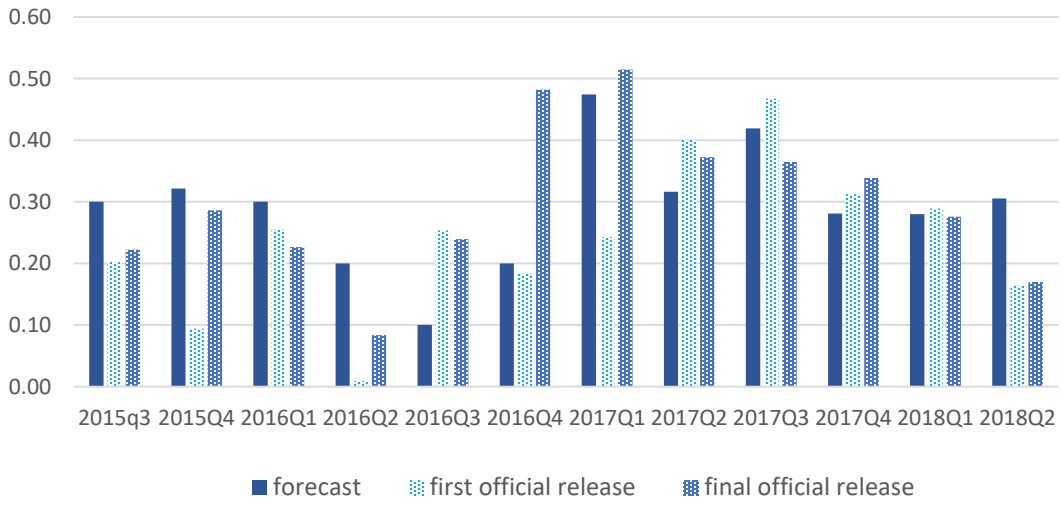
The short term forecasts for GDP and Industrial production are published each quarter in our short term outlook ("Nota Congiunturale").

We also consider risks and measures of uncertainty.



Three years of nowcasting at PBO

- We summarize the results coming from several models by using median/average of forecasts so as to reduce the error made by single models.
- We include judgement, in order to consider known events that are not (yet) included in the data (e.g. political instability)
- In the last 3 years we have produced nowcast/forecast with an acceptable error (0,05 on average). Forecasts seem to be conservative (pessimistic in good times and optimistic in bad times).



Summary and conclusion

- Nowcasting is relevant for Fiscal councils, either to produce their own forecasts or to assess the plausibility of forecasts made by others (e.g. produced by the Government).

- At PBO we use different models in order to reduce the forecasting error; each model captures specific characteristics of the national economy (e.g. international trade, national demand…).

- Three years of experience at UPB show quite good results in terms of reliability of our forecasts.